The Environmental Post-Mission Analysis System: Through-The-Sensor to the Warfighter

B.Y. Lin, S.A. Myrick, W.E. Avera, and M.M. Harris
Marine Geosciences Division

Managing a Sea of Environmental Data: The highly skilled, but leaner crews of today's Navy are tasked with compiling ever-increasing amounts of environmental knowledge. The mine hunter's arsenal bristles with data-gathering equipment: side-scan sonar, unmanned underwater vehicles, and meteorological sensors. Compounded with the work required to deploy, retrieve, and maintain this equipment, downloaded data from these platforms can easily overwhelm operators, and post-mission analysis may fall behind. Navy scientists at NRL develop data processing tools and algorithms to enable the warfighter to do more work in fewer steps, but there is a need for seamless data processing integration "to ensure data are visible, available, and usable, when needed and where needed, to accelerate decision-making."[1] NRL's Environmental Post-Mission Analysis (EPMA) system addresses this need with a powerful, cross-platform data analysis system that manages the compilation and integration of environmental data. EPMA is being developed for the mine warfare community, but will also have broader data analysis applicability. The system ingests and processes field data and formats it into products that can be used in analysis tools and prediction models to allow informed and timely decision-making.

Marshalling Through-the-Sensor Output: In the course of processing environmental data, one encounters no end of data format varieties. For example, an operator may download raw side-scan sonar imagery in proprietary format, convert it to a common processing format, and then export it as a geo-rectified TIFF image. Each of these manifestations of the data has a specific purpose. In the EPMA system, this smallest operable collection of data is called an EPMA data set, and it is tagged with an EPMA data type. To manage and integrate disparate data outputs, EPMA defines a unified, extensible data type system to help discriminate into what processes a data set can be fed. In the most basic sense, an EPMA data type is a triplet of attributes: logical parameter, conceptual representation, and physical storage format. A collection of *bathymetry* may be arranged in a *grid* of points, stored in a *CHRTR* formatted file (Fig. 9). Along with extra metadata externalized by the data type, this aggregation, or attribution, gives EPMA more actionable information about the data set than what can be inferred from the file name or file extension alone.

Process Automation: NRL is a leading developer of tools and algorithms for advanced image processing, environmental modeling and prediction, and visualization of the battlespace, among other capabilities. In the EPMA system, a processing module encapsulates each of these capabilities, and presents an input and output interface using the EPMA data type system. These processing modules can be chained together based on type compatibility in a semi-automated workflow. Moreover, EPMA can manage the mundane details of file management and processing job control, freeing the operator to focus on higher levels of information interpretation and tactical decision-making.[2]

Developing a Sustainable Open Framework: Systematic and effective software reuse is left out of the design and implementation of many software systems. Software reuse can reduce development cycles and costs, decrease maintenance effort and expense, lengthen software life-spans, and speed technology transition times. EPMA's system architecture has been designed to take full advantage of software reuse. EPMA defines interfaces and a plug-in framework that allows new modules to be added in with a plug-and-play capability (Fig. 10). A module might be a basic, input-output processing block, an extension of the user interface or visualization technique, or might also combine other modules in a new workflow. The new plug-ins can be added at runtime, giving the user new operational capabilities. From the viewpoint of the module developer, EPMA is a robust application programmer's interface (API) that offers high-level data management, process control, and a set of reusable user interface widgets, such as map views.

Post-Mission Analysis for the Future: All aspects of the EPMA system are engineered to address the data-driven needs of the future net-centric warfare. Good software design combined with the cutting-edge capabilities developed by NRL make EPMA not only an immediately useful application for the mine warfare community, but also a solid framework for general-purpose data analysis operations. Its utility has been shown with the first major release of EPMA Build 1.0. EPMA Build 2.0, slated for a 2009 release, boasts a matured implementation of the system.

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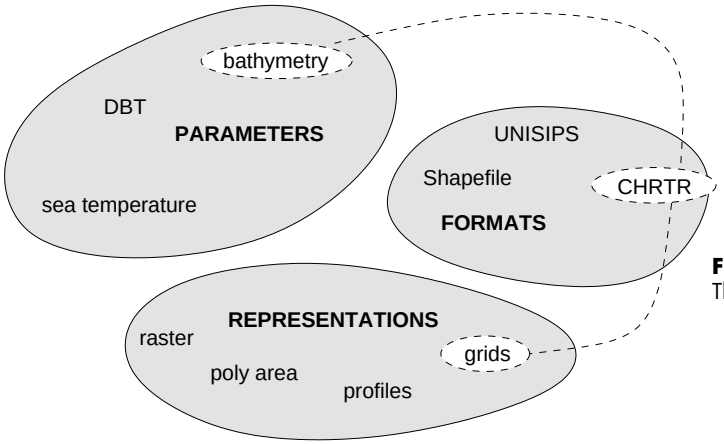

FIGURE 9
The EPMA data type system.

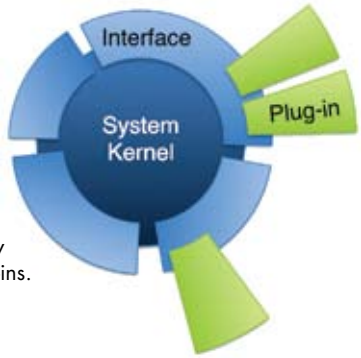

FIGURE 10
Extending capability through EPMA plug-ins.

the Naval Oceanographic Office who are jointly developing the EPMA with NRL.

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